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ABSTRACT

Current assessment practices in the classroom can affect the movement toward a child-centered curriculum in mathematics education. The mathematical community is addressing the challenge to implement standards in the areas of testing, assessment, and accountability in order to maintain this movement. This digest: (1) discusses what makes current assessment practices in mathematics education problematic, (2) outlines assessment principles to guide the mathematics education community in the establishment of assessment standards, and (3) reviews research results about alternative assessment. Current practices identified as problematic include tests that stress routine rote tasks instead of offering students the opportunity to demonstrate their mathematical powers; assessment that is used for ranking students and not as a tool of instruction; and instruction that teaches toward the test. Lists of the principles and goals established at the National Summit on Mathematical Assessment held in April 1991 and the principles developed by the New Standards Project are given to guide the development of assessment standards. Research results about alternative assessment practices involving portfolios, cooperative group assessment, and student behavior during assessment are cited. The drive toward standards-based education will not be complete without assessment standards. Contains 10 references. (MDH)

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# Approaching Standards for Mathematics Assessment

*Patricia A. Brosnan & Martin D. Hartog*

It is acknowledged that the typical mathematics curriculum of a generation ago emphasized teaching facts, standard procedures, and skills to groups of passive recipients. In the last decade, a more integrated, child-centered curriculum presented to more active, participating students has emerged in response to deteriorating public confidence in the quality of American education. However, curriculum, designed on the finest principles with the very best intentions, effects no change in classroom practice if assessment procedures remain the same [National Council of Teachers of Mathematics (NCTM), 1989; Mathematical Sciences Education Board & National Research Council (NRC), 1993]. Realizing this, the mathematical community is addressing multiple challenges to articulate and implement effective standards in the key areas of testing, assessment, and accountability. American students are subjected to a variety of tests, usually standardized, multiple-choice tests, from kindergarten to graduate school. Such tests are, according to widely held beliefs, inhibitors to change and improvement in education—especially in mathematics (MSEB & NRC, 1993). To make assessment instruments agents of change rather than preservers of the status quo, there are several major issues that must be addressed:

- Are current assessment practices and reporting methods problematic?
- What guiding principles should the mathematics community uphold when revamping assessment practices?
- Will alternative assessment methods really make a difference?
- Should use of alternative assessments be mandated?
- Should technology be available at all times?

With these issues emerge problems such as:

- How can assessment be designed equitably?
- Do all students have equal access to technology?
- How can standards be implemented nationally?
- Who will assess the assessment process? Who will enforce the standards?
- What needs to be done to convince teachers to change?

### What Makes Current Assessment Practices and Reporting Methods Problematic?

States and districts providing leadership in American education have identified the lack of shared standards for student achievement and good methods for assessment as the greatest obstacles to creating high performing schools. It is all too clear that current tests used for assessment of educational performance fail to measure adequately progress toward national standards (MSEB, 1993). This is especially true in mathematics, where curriculum and teaching standards recommended by the NCTM reflect broad nationwide consensus.

The new curriculum Standards call for an instructional setting that is very different from the classroom settings of the past. The curriculum combines new as well as traditional mathematical topics. Mathematics is presented to students in the form of rich situational problems that actively involve the students. Nonetheless, commonly used tests continue to stress routine, repetitive, rote tasks instead of offering children opportunities to demonstrate the full range of their mathematical power, including such important facets as communication, problem solving, inventiveness, persistence, and curiosity (MSEB, 1993).

Traditionally, instruction has been driven by the curriculum, but assessment has not been an effective part of a feedback loop linked to instruction. Assessment is most valuable when it is an integral part of teaching, not merely a tool for ranking students, but a mechanism for influencing instruction. To realize the full potential of the assessment process requires that the profession develop and implement assessment tasks to measure student productivity and performance on tests that require mathematical thinking (Pandey, 1990).

For too long teachers have been "teaching the test", students have been most interested in learning what will be on the test, and administrators have gauged progress from the results of these tests. If administrative personnel continue to demand and value static scores, teachers will continue to gather the type of data needed to make such a limited report. So, to change assessment practices, administrators must change what is required on reporting mechanisms.

### What Guiding Assessment Principles Should the Mathematics Education Community Uphold?

A National Summit on Mathematical Assessment was held 23-24 April 1991 (MSEB, 1991). From the summit emerged a consensus that the evaluation standards of the NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989) must be expanded. The following list of principles and goals for mathematical assessment was developed to guide the proposed expansion.

*Principles*

1. The primary purpose of assessment is to improve learning and teaching.
2. The primary use of results of assessment is to promote the development of the talents of all people.
3. The content of assessments is derived from the consensus of the discipline.

*Goals*

1. Assessments will be aligned with the mathematical knowledge, skills, and processes that the nation needs all of its students to know and be able to do.
2. Assessment practices will promote the development of mathematical power for all students.
3. A variety of effective assessment methods will be used to evaluate outcomes of mathematics education.
4. Adequate accountability systems will be used to assess mathematics.
5. Guidelines will be developed for judging the quality of all forms of mathematics assessments.
6. Mathematics teachers and school administrators will be proficient in using a wide variety of assessment methods for improving the learning and teaching of mathematics.
7. The public will become better informed about assessment and assessment practices (Mathematical Sciences Education Board, 1991, pp. 16-19).

As a result of this summit, the National Center on Education and the Economy (NCEE) based in Rochester, NY and the University of Pittsburgh Learning Research and Development Center (LRDC) were charged with the task of developing *The New Standards Project* . This *Project* team would produce standards for assessment that would align with previous standards in curriculum and teaching in mathematics, as well as in other academic disciplines. These standards will emphasize the ability to think well, to demonstrate a real understanding of subjects studied and to apply what one knows to the kind of complex problems encountered in life. *The New Standards Project* system will employ advanced forms of performance assessment, including portfolios, exhibitions, projects and timed performance examinations, all based on the use of real-life tasks that students are asked to do alone and in groups. Some tasks can be completed in minutes, but others will take weeks or even months. The first valid, reliable, and fair exams will be available for use in mathematics by 1994.

The goal is not simply to measure student performance, but to improve it significantly. The following principles, developed by the *New Standards* team,

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provide the framework from which the new assessment standards will emerge.

*Principles*

1. It is possible to have an educational system that is both equitable and excellent.
2. Student performance standards and assessment systems will be designed to help bring all groups of students to high levels of performance.
3. Children should not be denied the right to a first-class education because they go to school in one state rather than another or in one school district rather than another.
4. The standards set will emphasize thinking and students' capacities to use what they know outside a school setting.
5. Although the standards will be uniform, schools will be free to use very different methods to help students achieve the new standards through a variety of means that will enable them to take advantage of the strengths of their backgrounds and experiences.
6. Standards will be set through a public process that engages all sectors of society throughout the nation.
7. Assessments will be deliberately designed as targets for instruction and learning.
8. Teachers and content specialists will be actively involved in developing, grading, and interpreting the assessments.
9. Students, parents, and teachers must be convinced that competence as demonstrated on the assessments will lead to real opportunity for further education and jobs with advancement prospects (The National Center on Education and the Economy, 1991, pp. 9-10).

*Standards for Teacher Competence in Educational Assessment of Students* were concurrently developed by the American Federation of Teachers (AFT), the National Council on Measurement in Education (NCME), and the National Education Association (NEA) (1990) requiring that:

1. Teachers should be skilled in *choosing* assessment methods appropriate for instructional decision.
2. Teachers should be skilled in *developing* assessment methods appropriate for instructional decisions.
3. Teachers should be skilled in *administering, scoring, and interpreting* the results of both externally-produced and teacher-produced assessment methods.
4. Teachers should be skilled in *using* assessment results when making decisions about individual students, planning teaching, developing curriculum, and school improvement.
5. Teachers should be skilled in *developing* valid pupil grading procedures which use pupil assessments.
6. Teachers should be skilled in *communicating* assessment results to students, parents, other lay audiences, and other educators.
7. Teachers should be skilled in *recognizing* unethical, illegal, and otherwise inappropriate assessment methods and use of assessment information. (pp. 3-5)

With these teacher competence standards and the proposed assessment standards on the horizon, the question must be raised, "Will alternative assessment methods really make a difference?"

**What Do Early Research Results Suggest About Alternative Assessment?**

Large scale assessment programs are beginning to assign assessment tasks in which groups of students work collaboratively to solve problems or complete projects. Research results show that, in the group setting, performance is much better than in the individual setting. While the data provide important insights into students' mathematics skills and their behavior in cooperative groups, little is known about the validity of data from group assessment for making inferences about the competence of individual students (Webb, 1992).

The effects of portfolio assessment on mathematics students' attitudes about grades, their awareness of their mathematical strengths and weaknesses, and their abilities to set reasonable goals were studied. Results suggest that portfolio assessment might help students see their strengths and weaknesses so that they are more able to link successes and failures to performance. Portfolio assessment might also facilitate goal setting (Owings & Follo, 1992).

Results of innovative assessment indicate that some students performed surprisingly well and were able to explain concepts in detail. If a question was rephrased, students were able to do very well explaining a problem in contrast to drawing a blank on traditional tests. Others did not do as well as expected, demonstrating an inability to explain concepts, and relying on memorized facts and simple computation (Lehman, 1992).

In response to the call for assessment reform, many states such as California, Connecticut, Vermont, Kentucky, Virginia, and Ohio have been experimenting with alternative forms of assessment on a statewide basis and early reports include similarly promising results. Likewise, on a national level, the Educational Testing Service, the National Assessment of Educational Progress, and the College Board are all working towards implementation of open-ended assessment items as well as incorporating the use of technology in their testing programs. Scientific calculators will be allowed on the 1994 SAT and graphing calculators will be permitted in 1995—a clear movement in the direction of mathematical empowerment.

**Summary**

As the United States moves resolutely towards standards-based education, we must learn how to measure the quality of students' learning through performance. Traditional testing in the United States measures only the individual, valuing competition over cooperation. Just as our nation needs standards in curriculum and teaching, so too we need standards for assessment. Without such standards, we will continue, unwisely, to measure what is convenient rather than what is most important. Our nation's drive towards standards-based education will not be complete until joined with appropriate assessment (MSEB, 1993). Operating from the point of view that instruction and assessment are closely linked, that good teachers constantly assess students informally, that student self-evaluation is a vital part of learning, that formal assessments are stronger if they relate closely to the content and form of classroom instruction, and that documentation of assessment is important in connecting classroom work to external evaluation, mathematics educators may indeed be able to formulate assessment practices that will elicit improved mathematical achievement (Stenmark, 1991).

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